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International Journal of Advances in Social Sciences and Humanities

Journal homepage: https://journal.srnintellectual.com/index.php/ijassh

Article

Applying the Multiple-Attribute Decision Making - Simple Additive Weighting to determine the Most Popular Internet Provider among Students

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Citations: Manik, C.T.S. (2022). Applying the Multiple-Attribute Decision Making - Simple Additive Weighting to determine the Most Popular Internet Provider among Students. *International Journal of Advances in Social Sciences and Humanities*, 1(4), 211-216.

Academic Editor: Mursalin.

Received: 20 August 2022 Accepted: 6 November 2022 Published: 30 November 2022

Abstract: The rapid development of information technology makes internet access an important requirement in many aspects. The COVID-19 pandemic has also become the basis for the increasing use of internet access, especially in the education sector. Restrictions activities outside the house, causing the productivity of students to decline. Therefore, in order to remain active and productive, students are required to follow an online learning system. This will make the use of internet quota even greater. The number of cellular providers that provide internet services sometimes makes users confused in determining which provider is better to use. In this study, the Multiple-Attribute Decision Making (MADM) - Simple Additive Weighting (SAW) methods used to identify the decision support system in determining the type of cellular provider that is the most popular among students, especially in the Griya Martubung Area. This decision support system can certainly meet the needs of internet quotas and budgets. The results show that the most popular providers are Three, followed by Telkomsel, XL Axiata, Smartfren and Indosat.

Keywords: internet provider; internet access; multiple-attribute decision making; simple additive weighting; Griya Martubung.

1. Introduction

Today, internet access is one of the most important aspects (Mattern & Floerkemeier, 2010), especially during the COVID-19 pandemic, almost all activities are becoming online (Alsoud & Harasis, 2021; Azlan et al., 2020; Dhawan, 2020; Hanaei et al., 2022; Naik et al., 2021). In 2020, the Indonesian people facing the challenges of how to stay connected and doing activities without leaving the house. The pandemic has brought a new culture of digitalization in many sectors, including education (Alsoud & Harasis, 2021; Azlan et al., 2020; Dhawan, 2020; Naik et al., 2021). The COVID-19 pandemic forced students to continue their activities as usual even without meeting face to face (Kulikowski et al., 2022; Simamora, 2020). In order to stay connected to each other, the use of various applications to support learning activities is also increasing rapidly. Along with that, the need for internet services is also increasing. The

government through the Ministry of Education and Culture provides quota assistance for students, teachers and lecturers that will be sent regularly to mobile numbers which is registered through schools. However, not infrequently the registered mobile number is no longer active so the assistance provided cannot be used. This causes parents must spend some additional funds for internet quotas so that online learning activities can still be carried out.

The number of internet providers, in this case cellular providers, causes students confused to choose which one of the cellular providers they will use. Expensive internet quota and poor internet connection can be an obstacle to student activities and productivity. To make it easier for students to determine which cellular provider they will use, it is necessary to have a decision support system in choosing one of the various types of cellular providers available. This decision support system can certainly meet the needs of internet quotas and budgets. The type of cellular provider selection system depends on many criteria, so an appropriate decision support method is needed. Various literatures provide many methods of decision support systems. One of them is Multi Attribute Decision Making – Simple Additive Weighting (MADM-SAW) methods. The use of the SAW method is based on its ability to make a more precise assessment because it is based on predetermined criteria values and preference weights. Beside of that, this method is performing a ranking process to select the best alternative from a number of existing alternatives. In this study, the SAW method will be used as a decision support method in determining the type of the most popular cellular provider. The purpose of this study is to determine the best choice of each criteria, sub-criteria and alternatives according to the wishes and needs of the cellular provider using the SAW method. With this decision-making support system, it is hoped that it can assist students in determining the type of cellular provider to use, so that online learning activities are carried out properly, without disturbing by network speed and without spending excessive funds to buy internet quota.

2. Literature Review

2.1. Multiple-Attribute Decision Making (MADM)

Multiple-Attribute Decision Making (MADM) is a branch of science that is generally used in comparing a limited set of alternatives (Alinezhad & Khalili, 2019). In management and planning, MADM has been used to study decision methods and procedures that can accommodate some of usual conflicting criteria (Büyüközkan et al., 2009). MADM model is a decision matrix consisting of ranking alternatives against each criterion. The evaluation rankings were collected by considering the weight of the criteria, and the global evaluation score for each alternative found (Nasab & Milani, 2012). There are several MADM methods including Simple Additive Weighting Method (SAW), Weight Product (WP), ELECTRE, Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), and Analytic Hierarchy Process (AHP).

2.2. Simple Additive Weighting (SAW)

Simple Additive Weighting (SAW) method is known as the weighted addition method (Haswan, 2019). The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all attributes (Purba & Sihotang, 2019; Putra & Punggara, 2018). The SAW method requires the process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings (Kusumadewi et al., 2006). According to Darmastuti (2013), the advantage of the Simple Additive Weighting (SAW) model is in its ability to make a more precise assessment because it is based on predetermined criteria values and preference weights. Beside that, in the SAW method there is a matrix normalization calculation which is suitable to the value of the benefit and cost attributes (Afifah, 2012). According to Cahyapratama & Sarno (2018), the determination of the priority value of the weight vector is carried out according to the manager's policy to provide the weight vector value directly. The steps are as follows:

a) Determine the criteria that will be used as a reference in decision making, namely Ci

b) Determine the suitability rating of each alternative on each criterion.

c) Make a decision matrix based on the criteria (Ci), then normalize the matrix based on the equation that is adjusted to the type of attribute (profit or cost attribute) in order to obtain a normalized matrix R.

The formula for normalization is expressed by:

$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{Max_i(X_{ij})} \\ \dfrac{Min_i(X_{ij})}{X_{ij}} \end{cases} \quad (1)$$

Where:

r_{ij} = normalized performance rating

X_{ij} = alternative and criteria of matrix

Max_i = maximum value of each alternative and criteria

Min_i = minimum value of each alternative and criteria

The final result of each ranking process is the sum of the normalized matrix multiplication R with the weight vector (w) so that the largest value is chosen as the best alternative solution (Ai). The preference value for each alternative (Vi) is expressed by:

$$V_i = \Sigma_j^n w_j r_{ij} \quad (2)$$

Where:
V_i = alternative final result
w_j = predetermined weight
r_{ij} = matrix normalization

3. Materials and Methods

This study is done by using the step-by-step for the flow of research, the research flow as seen in Figure 1 below:

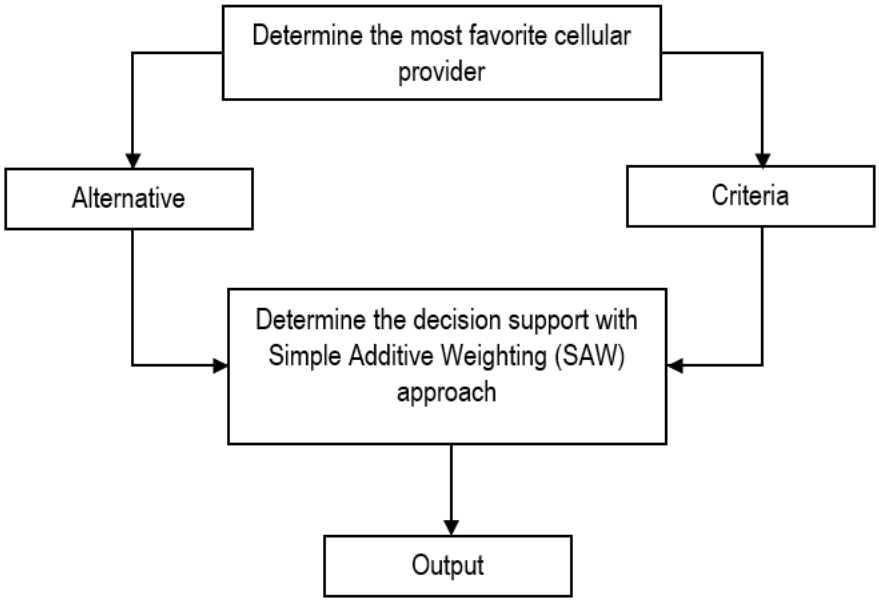

Figure 1. Step-by-Step Flowchart of Research

3.1. Alternative Variables and Criteria Variables

The alternative variables and criteria variables must be determined so that the process of determining decision support can be carried out. The variables of alternative and criteria are as follows :

- The alternative variable is the available type of cellular provider at the study location, namely:
  a) Telkomsel
  b) 3 (Three Hutchison)
  c) Smartfren
  d) Indosat
  e) XL axiata
- The criteria variables that will be used to determine the type of favorite cellular provider are:
  a) Internet network quality
  b) Internet quota price
  c) Service provider

The sub-criteria referred in network quality are including upload speed, download speed, latency, coverage area and internet network stability. Internet quota price sub-criteria are including the price of internet packages, internet vouchers, and starter card. Service provider sub-criteria are including daily/weekly/monthly internet package promos,

learning platform promos, YouTube/streaming internet quota bonuses, and package validity extensions. In this study, the data used are primary data from respondents to determine the weight of the criteria and assessment of the type of cellular provider by students at the research site.This study was conducted in Griya Martubung area, Medan city.This study used the accidental sampling technique from students in studies location. The total number of respondents is 150 people.

4. Results and Discussion

The initial step must be taken so that we get a decision matrix is determining the value of each alternative (A_i) from the 150 respondents recorded on the basis of each criteria. (C_i), the result as seen in Table 1 below:

Table 1. Value of Each Alternative (A_i)

Alternative	Criteria		
	C1	C2	C3
Telkomsel	30	15	40
3 (Three Hutchison)	50	60	40
Indosat	15	25	25
Smartfren	25	15	15
XL Axiata	30	35	30

Table 1 displays the result of alternative value on the basis of several criteria denoted by C1, C2 and C2. The first alternative is Telkomsel with the criteria values are C1 = 30, C2 = 15, and C3 = 40. 3 (Three Hutchison) criteria values are C1 = 50, C2 = 60, and C3 = 40. Indosat criteria values are C1 = 15, C2 = 25, and C3 = 25. Smartfren criteria values are C1 = 25, C2 = 15, and C3 = 15 and XL Axiata criteria values are C1 = 30, C2 = 35, and C3 = 30. By giving a weighted value (w) for each criterion, the result as seen in Table 2.

Table 2. Result of Weighted (w) for Three Criterions

Criteria	Category	Weighted
C1	Internet network quality	0.50
C2	Internet quota price	0.18
C3	Service provider	0.32

Table 2 shows the result of weighted (w) for three criterions. The result indicates that Criteria 1 (C1) is the provider selected due to internet network quality (w=0.50). Also, Criteria 2 (C2) is the provider selected due to internet quota price (w=0.18) and Criteria 3 (C3) is the provider selected due to services (w=0.32). In addition, this study employs the normalize data on the basis of benefit and cost attributes. It aims to obtain a decision matrix. Internet quota price criteria are categorized as cost attributes, while network quality and provider services are categorized as benefit attributes. The normalized matrix is given in Table 3.

Table 3. Result of Normalised Matrix

Alternative	Criteria		
Weighted	C1	C2	C3
	0.50	0.18	0.32
Telkomsel	0.60	1.00	1.00
3 (Three Hutchison)	1.00	0.25	1.00
Indosat	0.30	0.60	0.63
Smartfren	0.50	1.00	0.38
XL Axiata	0.60	0.43	0.75

Table 3 captures the result of normalised matrix. In this case, we use alternative providers and criteria by adding the weighted. The result shows that the first alternative is Telkomsel with C1 (w=0.50) is 0.60, C2 (w=0.18) is 1.00 and C3 (w=0.32) is 1.00. 3 (Three Hutchison) with C1 (w=0.50) is 1.00, C2 (w=0.18) is 0.25 and C3 (w=0.32) is 1.00. Indosat with C1 (w=0.50) is 0.30, C2 (w=0.18) is 0.60 and C3 (w=0.32) is 0.63. Smartfren with C1 (w=0.50) is 0.50, C2 (w=0.18)

is 1.00 and C3 (w=0.32) is 0.38 and XL Axiata with C1 (w=0.50) is 0.60, C2 (w=0.18) is 0.43 and C3 (w=0.32) is 0.75. Further, the decision matrix is given in Table 4.

Table 4. Result of Decision Matrix

Alternative	Criteria		
	C1	C2	C3
Telkomsel	0.30	0.18	0.32
3 (Three Hutchison)	0.50	0.05	0.32
Indosat	0.15	0.11	0.20
Smartfren	0.25	0.18	0.12
XL Axiata	0.30	0.08	0.24

Table 4 indicates that decision matrix results with alternative internet provider on the basis of three criteria denoted by C1, C2 and C2. The first alternative is Telkomsel with the criteria values are C1 = 0.30, C2 = 0.18, and C3 = 0.32. 3 (Three Hutchison) with the criteria values are C1 = 0.50, C2 = 0.05, and C3 = 0.32. Indosat with the criteria values are C1 = 0.15, C2 = 0.11, and C3 = 0.20. Smartfren with the criteria values are C1 = 0.25, C2 = 0.18, and C3 = 0.12 and XL Axiata with the criteria values are C1 = 0.30, C2 = 0.08, and C3 = 0.24. In addition, this study uses rank of preferred internet providers. This ranking is done by summing the total value of each alternative for all criteria. The alternative with the highest score is the type of provider that is most popularly used among students, given in Table 5.

Table 5. The Outcomes of Preferred Internet Providers

Alternative	Total	Rank
Telkomsel	0.80	2
3 (Three Hutchison)	0.87	1
Indosat	0.46	5
Smartfren	0.55	4
XL Axiata	0.62	3

Table 5 displays the outcomes of preferred internet providers. The first rank is 3 (Three Hutchison) with the total value is 0.87. Second is Telkomsel with a total value is 0.80. XL Axiata, with the total value is 0.62 at position three. Smartfren is four with the total value is 0.55 and lastly is Indosat with the total value is 0.46.

5. Conclusions

In conclusion, this study identified that the most popular types of cellular providers among students sequentially are 3 (Three Hutchison), Telkomsel, XL Axiata, Smartfren and the last is Indosat. These results are given as a solution to choosing a cellular provider for students so that online learning activities run well by considering the various criteria and sub-criteria that have been described.n of your study. You may also put your personal reflection after conducting your study. Maximum 100 characters. The selection of the type of cellular provider for students using the SAW method is relatively simple, so it needs to be developed by using other methods so that the alternative selection process becomes better. Further development of this research can be done by considering other criteria, increasing the number of respondents or expanding the scope of the research area.

Author Contributions: Conceptualization, C.T.S.M.; methodology, C.T.S.M.; software, C.T.S.M.; validation, C.T.S.M.; formal analysis, C.T.S.M.; investigation, C.T.S.M.; resources, C.T.S.M.; data curation, C.T.S.M.; writing—original draft preparation, C.T.S.M.; writing—review and editing, C.T.S.M.; visualization, C.T.S.M.; supervision, C.T.S.M.; project administration, C.T.S.M.; funding acquisition, C.T.S.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Acknowledgments: The author would like to thank Universitas Efarina, Pematangsiantar, Indonesia for supporting this research and publication. We would also like to thank the reviewers for their constructive comments and suggestions.

Conflicts of Interest: The authors declare no conflict of interest.

References

Afifah, N. (2012). Sistem Pendukung Keputusan Penerimaan Beasiswa Magang Menggunakan Metode SAW (Simple Additive Weighting). *Jurnal Informatika - Madura: Universitas Trunojoyo*, *8*(1), 48–53. https://doi.org/10.30591/smartcomp.v8i1.1318

Alinezhad, A., & Khalili, J. (2019). *New methods and applications in multiple attribute decision making (MADM)* (Vol. 277). Springer.

Alsoud, A. R., & Harasis, A. A. (2021). The impact of COVID-19 pandemic on student's e-learning experience in Jordan. *Journal of Theoretical and Applied Electronic Commerce Research*, *16*(5), 1404–1414. https://doi.org/10.3390/jtaer16050079

Azlan, C. A., Wong, J. H. D., Tan, L. K., Huri, M. S. N. A. D., Ung, N. M., Pallath, V., Tan, C. P. L., Yeong, C. H., & Ng, K. H. (2020). Teaching and learning of postgraduate medical physics using Internet-based e-learning during the COVID-19 pandemic–A case study from Malaysia. *Physica Medica*, *80*, 10–16. https://doi.org/10.1016/j.ejmp.2020.10.002

Büyüközkan, G., Feyzioğlu, O., & Ersoy, M. Ş. (2009). Evaluation of 4PL operating models: A decision making approach based on 2-additive Choquet integral. *International Journal of Production Economics*, *121*(1), 112–120. https://doi.org/10.1016/j.ijpe.2008.03.013

Cahyapratama, A., & Sarno, R. (2018). Application of Analytic Hierarchy Process (AHP) and Simple Additive Weighting (SAW) methods in singer selection process. *2018 International Conference on Information and Communications Technology*, 234–239.

Darmastuti, D. (2013). Implementasi metode simple additive weighting (SAW) dalam sistem informasi lowongan kerja berbasis web untuk rekomendasi pencari kerja terbaik. *Jurnal Sistem Dan Teknologi Informasi*, *1*(2), 114–119.

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, *49*(1), 5–22. https://doi.org/10.1177/0047239520934018

Hanaei, S., Takian, A., Majdzadeh, R., Maboloc, C. R., Grossmann, I., Gomes, O., Milosevic, M., Gupta, M., Shamshirsaz, A. A., & Harbi, A. (2022). Emerging standards and the hybrid model for organizing scientific events during and after the COVID-19 pandemic. *Disaster Medicine and Public Health Preparedness*, *16*(3), 1172–1177. https://doi.org/10.1017/dmp.2020.406

Haswan, F. (2019). Application of Simple Additive Weighting Method to Determine Outstanding School Principals. *Sinkron: Jurnal Dan Penelitian Teknik Informatika*, *3*(2), 186–192. https://doi.org/10.33395/sinkron.v3i2.10082

Kulikowski, K., Przytuła, S., & Sułkowski, Ł. (2022). E-learning? Never again! On the unintended consequences of COVID-19 forced e-learning on academic teacher motivational job characteristics. *Higher Education Quarterly*, *76*(1), 174–189. https://doi.org/10.1111/hequ.12314

Kusumadewi, S., Hartati, S., Harjoko, A., & Wardoyo, R. (2006). *Fuzzy multi-attribute decision making (Fuzzy MADM)*. Graha Ilmu.

Mattern, F., & Floerkemeier, C. (2010). From the Internet of Computers to the Internet of Things. In *From active data management to event-based systems and more* (pp. 242–259). Springer.

Naik, G. L., Deshpande, M., Shivananda, D. C., Ajey, C. P., & Manjunath Patel, G. C. (2021). Online Teaching and Learning of Higher Education in India during COVID-19 Emergency Lockdown. *Pedagogical Research*, *6*(1), 1–14. https://doi.org/10.29333/pr/9665

Nasab, H. H., & Milani, A. S. (2012). An improvement of quantitative strategic planning matrix using multiple criteria decision making and fuzzy numbers. *Applied Soft Computing*, *12*(8), 2246–2253. https://doi.org/10.1016/j.asoc.2012.03.010

Purba, R., & Sihotang, H. T. (2019). Decision Support Systems Recipient Program Keluarga Harapan (PKH) In Durian Kec. Pantai Labu Kab. Deli Serdang with the Simple Additive Weighting (SAW) Method. *Jurnal Mantik*, *3*(3), 91–98. https://iocscience.org/ejournal/index.php/mantik/index

Putra, D. W. T., & Punggara, A. A. (2018). Comparison analysis of Simple Additive Weighting (SAW) and weigthed product (WP) in decision support systems. *MATEC Web of Conferences*, *215*, 1003.

Simamora, R. M. (2020). The Challenges of online learning during the COVID-19 pandemic: An essay analysis of performing arts education students. *Studies in Learning and Teaching*, *1*(2), 86–103. https://doi.org/10.46627/silet.v1i2.38